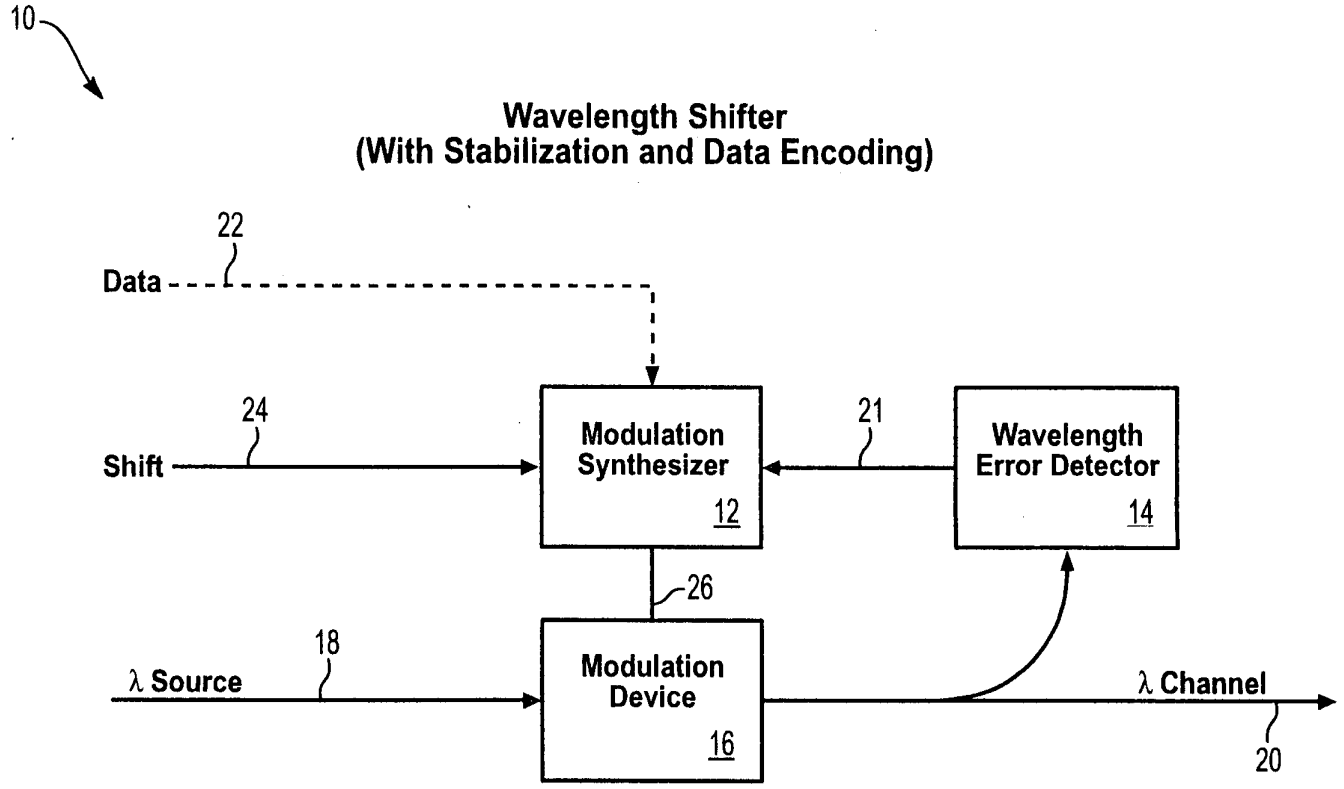

FIG. 1

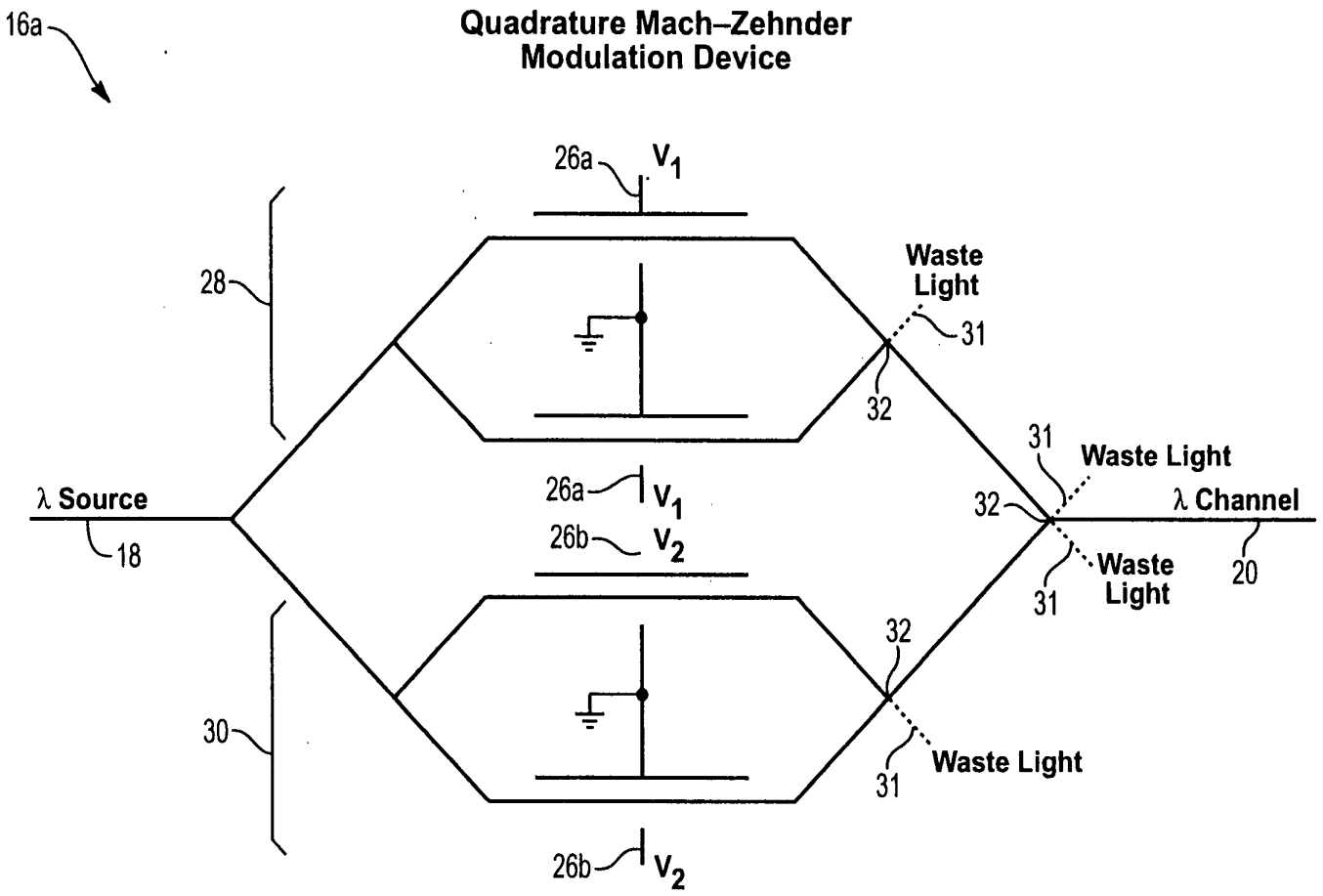
16a
Quadrature Mach–Zehnder
Modulation Device
26a
V_1
28
Waste
Light
31
32
λ Source
18
26a
V_1
26b
V_2
31
Waste Light
32
λ Channel
20
Waste
Light
31
32
30
Waste Light
31
26b
V_2

FIG. 2

Mach–Zehnder Device Transfer Function

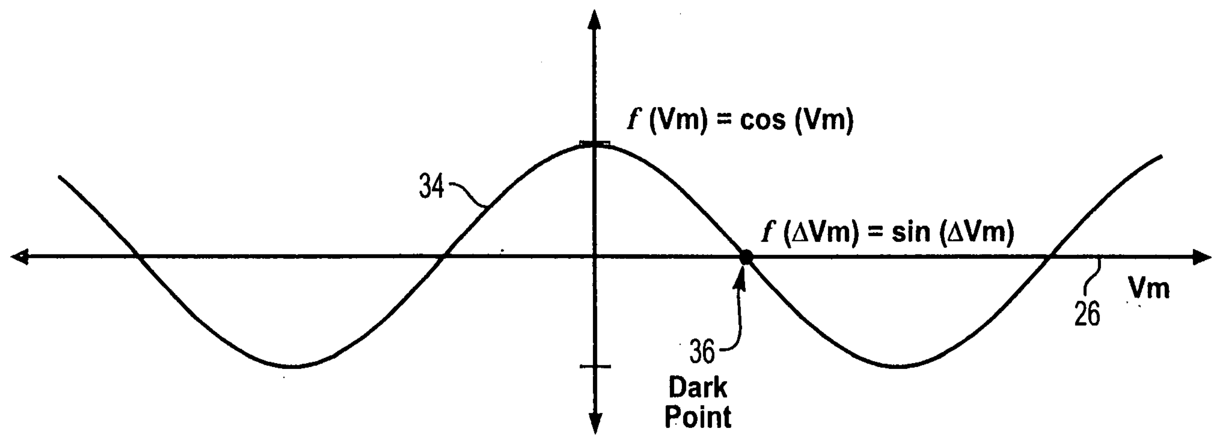

FIG. 3

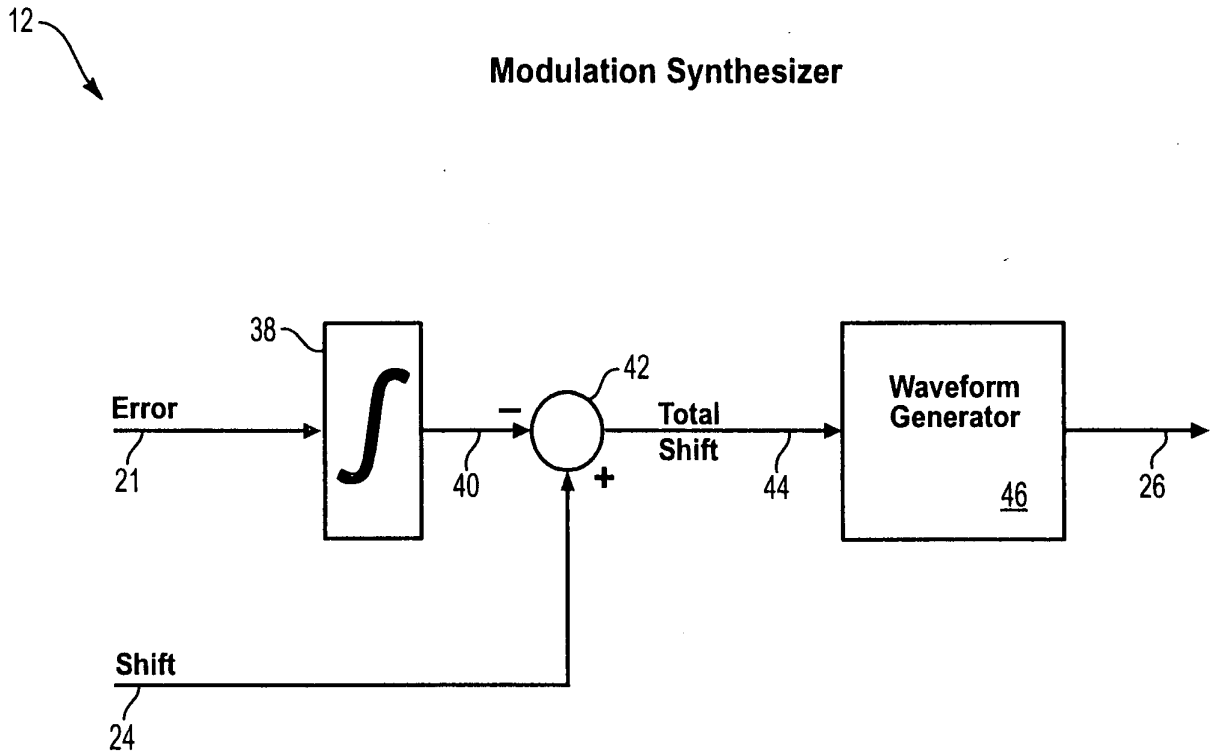
12
Modulation Synthesizer
38
42
Error
21
40
−
+
Total
Shift
44
Waveform
Generator
46
26
Shift
24

FIG. 4

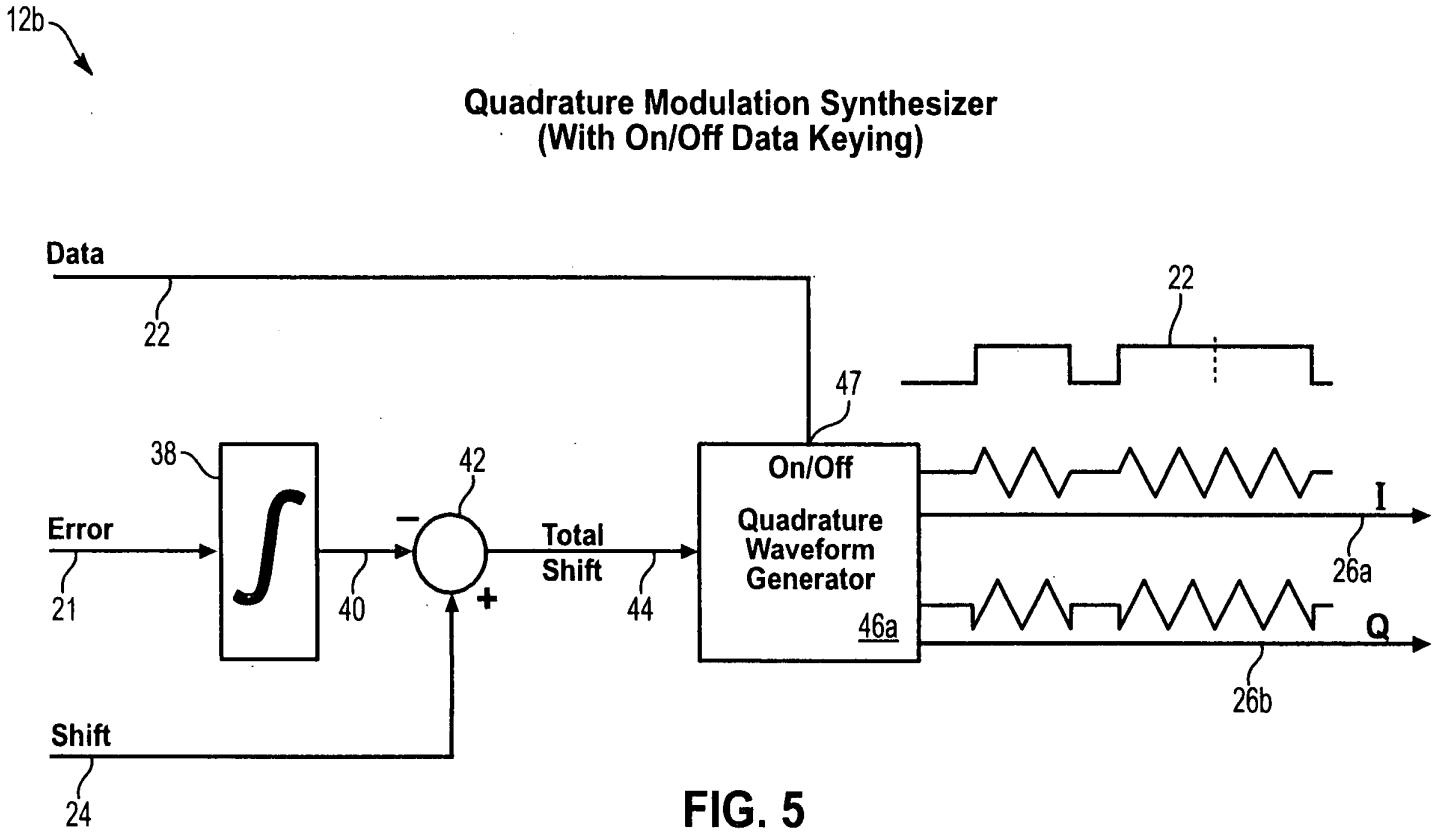

FIG. 5

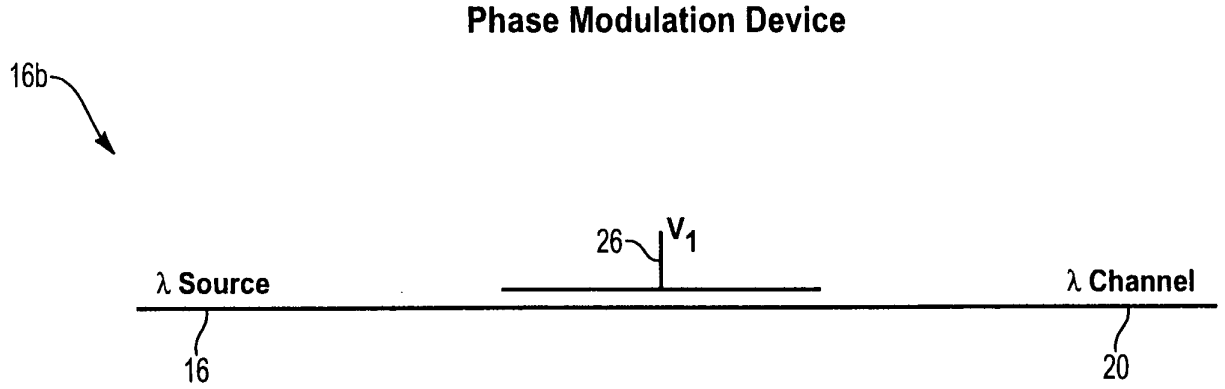

FIG. 6

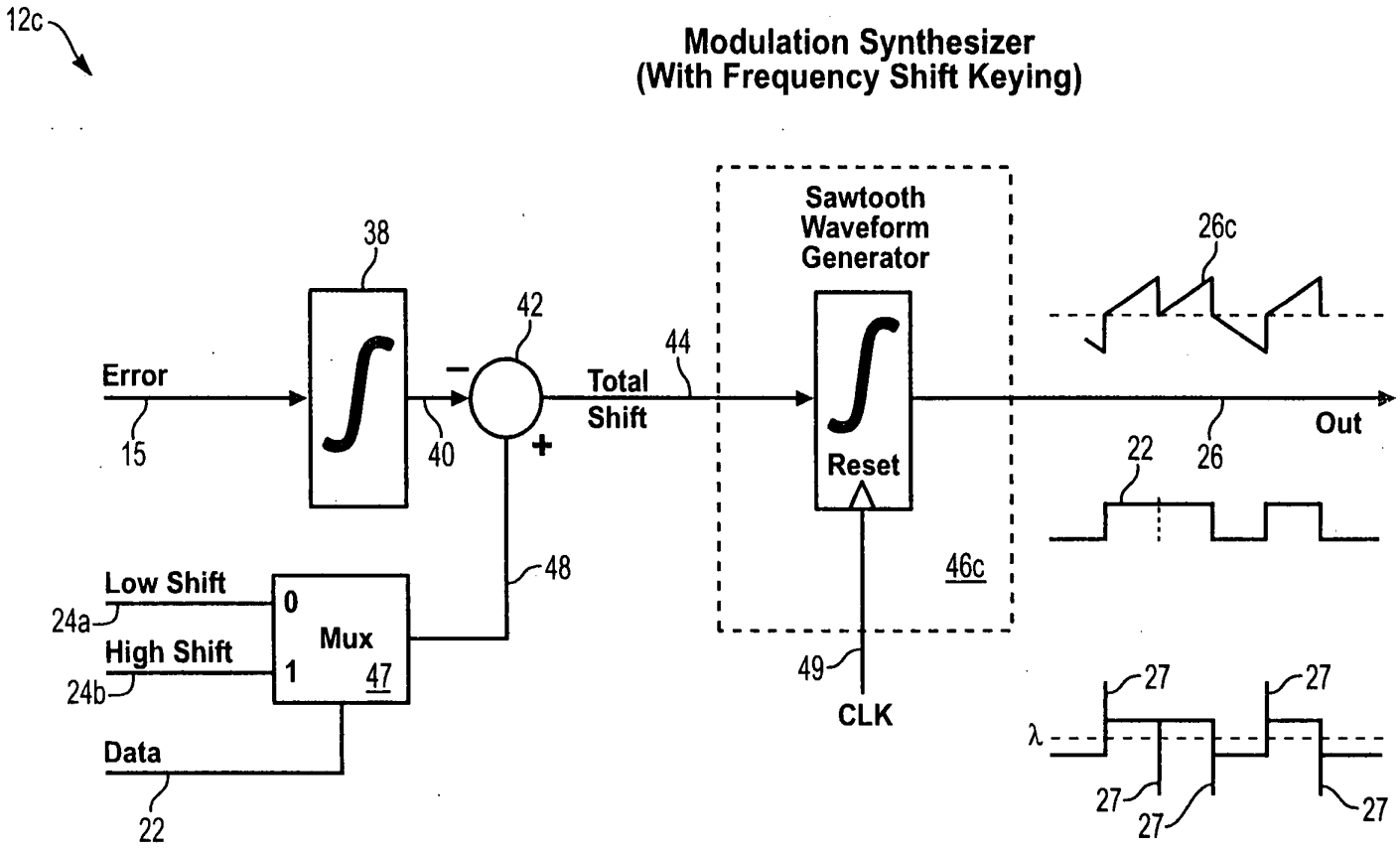
12c
Modulation Synthesizer
(With Frequency Shift Keying)
Sawtooth
Waveform
Generator
38
42
44
26c
Error
15
40
Total
Shift
Out
26
Reset
22
46c
48
Low Shift
24a
High Shift
24b
0
1
Mux
47
Data
22
49
CLK
27
λ

FIG. 7

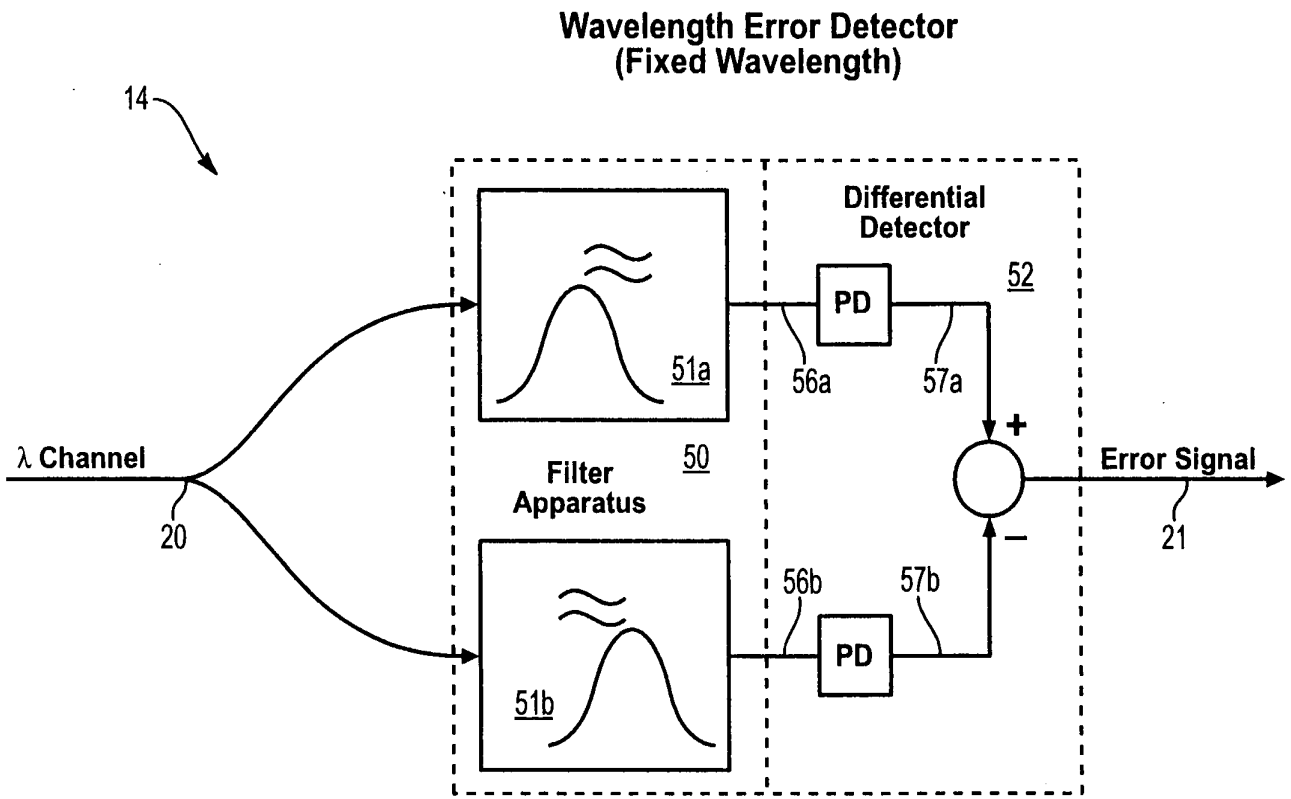
Wavelength Error Detector
(Fixed Wavelength)
14
Differential
Detector
52
PD
51a
56a
57a
+
λ Channel
Filter
Apparatus
50
Error Signal
20
21
56b
57b
PD
51b
−

FIG. 8

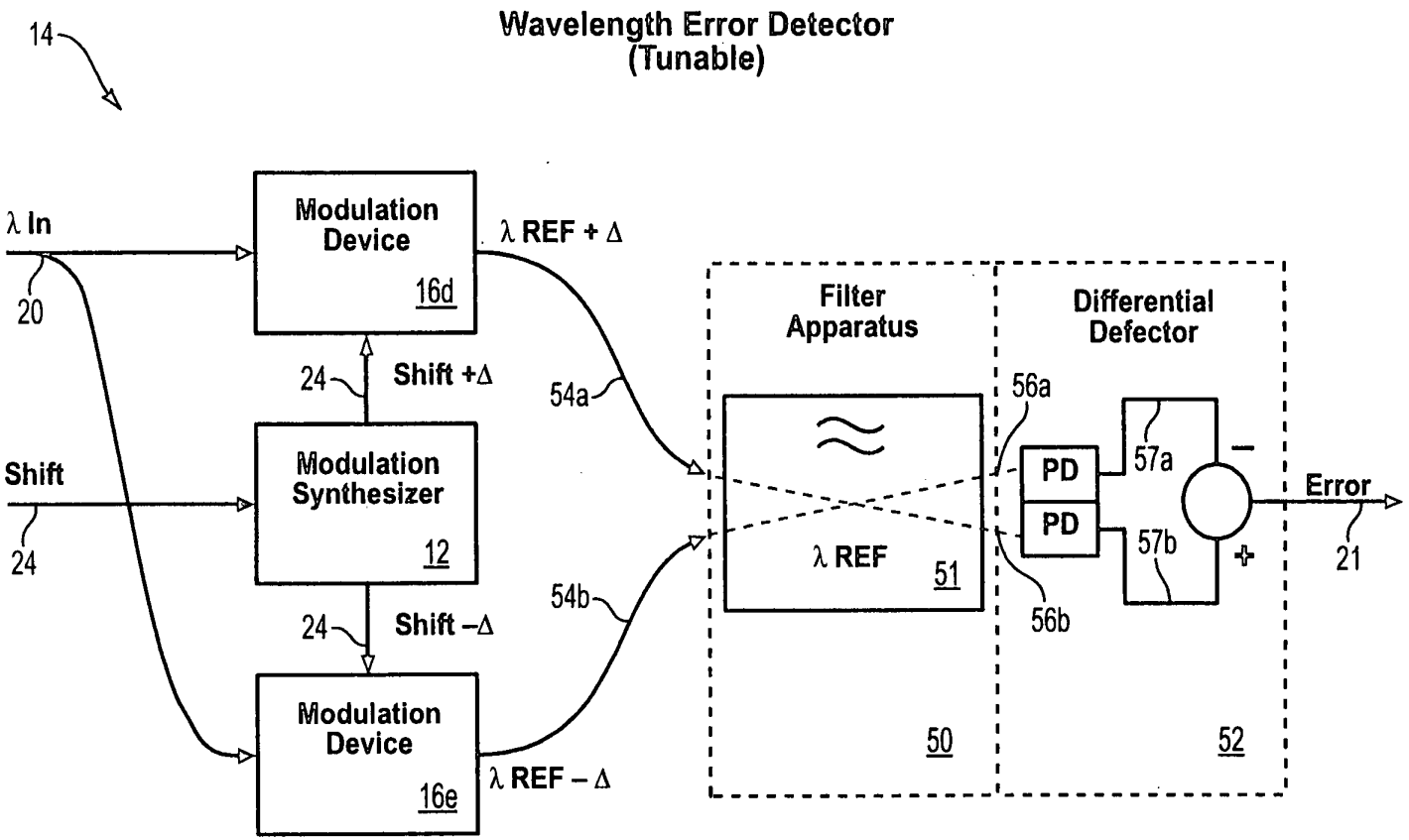
Wavelength Error Detector
(Tunable)
14
λ In
20
Modulation Device
16d
λ REF + Δ
24
Shift +Δ
Shift
24
Modulation Synthesizer
12
24
Shift –Δ
Modulation Device
16e
λ REF – Δ
54a
54b
Filter Apparatus
λ REF
51
50
Differential Defector
56a
56b
PD
PD
57a
57b
–
+
Error
21
52

FIG. 9

Wavelength Error Detector
(Tunable)

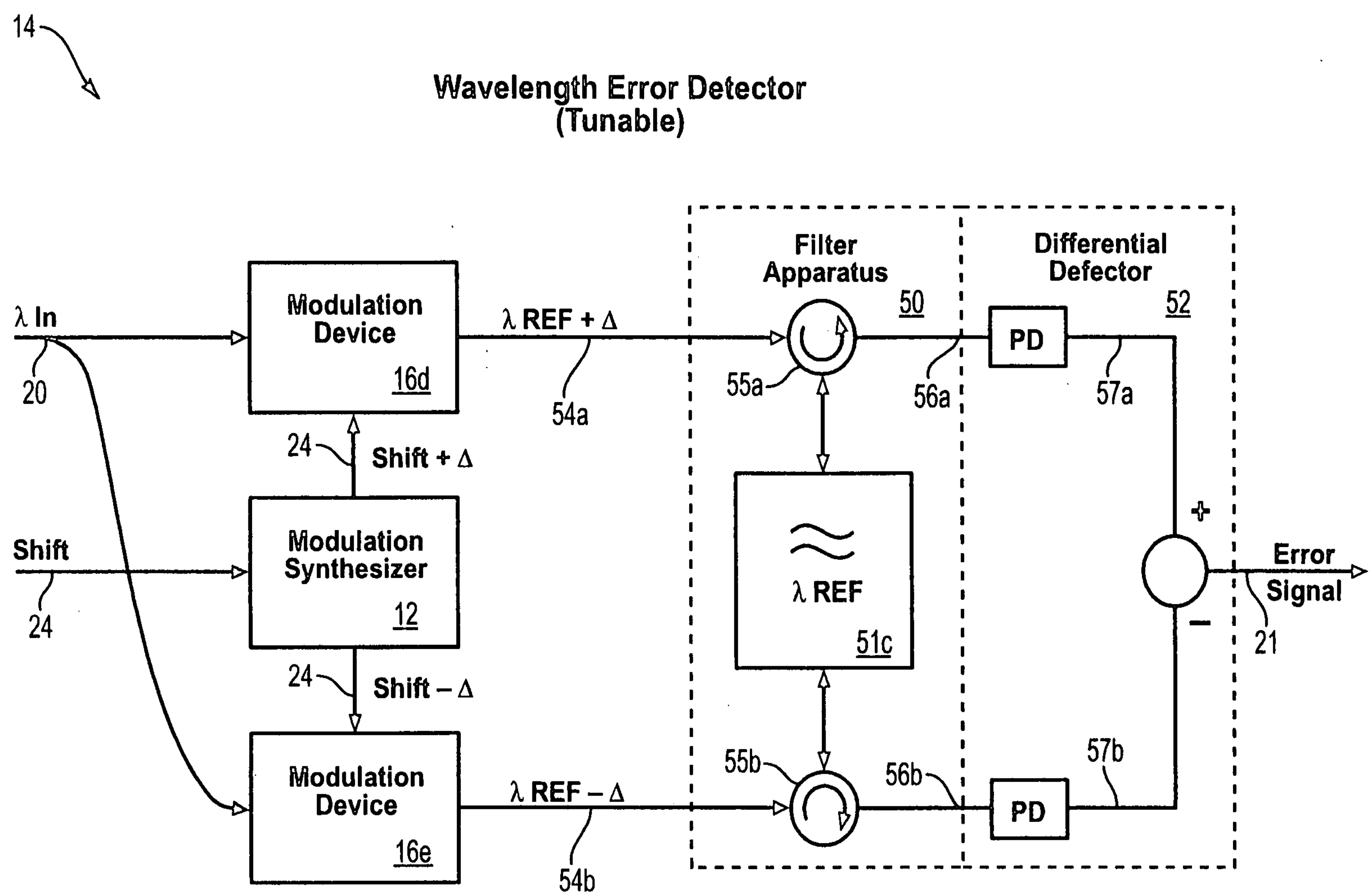

FIG. 10

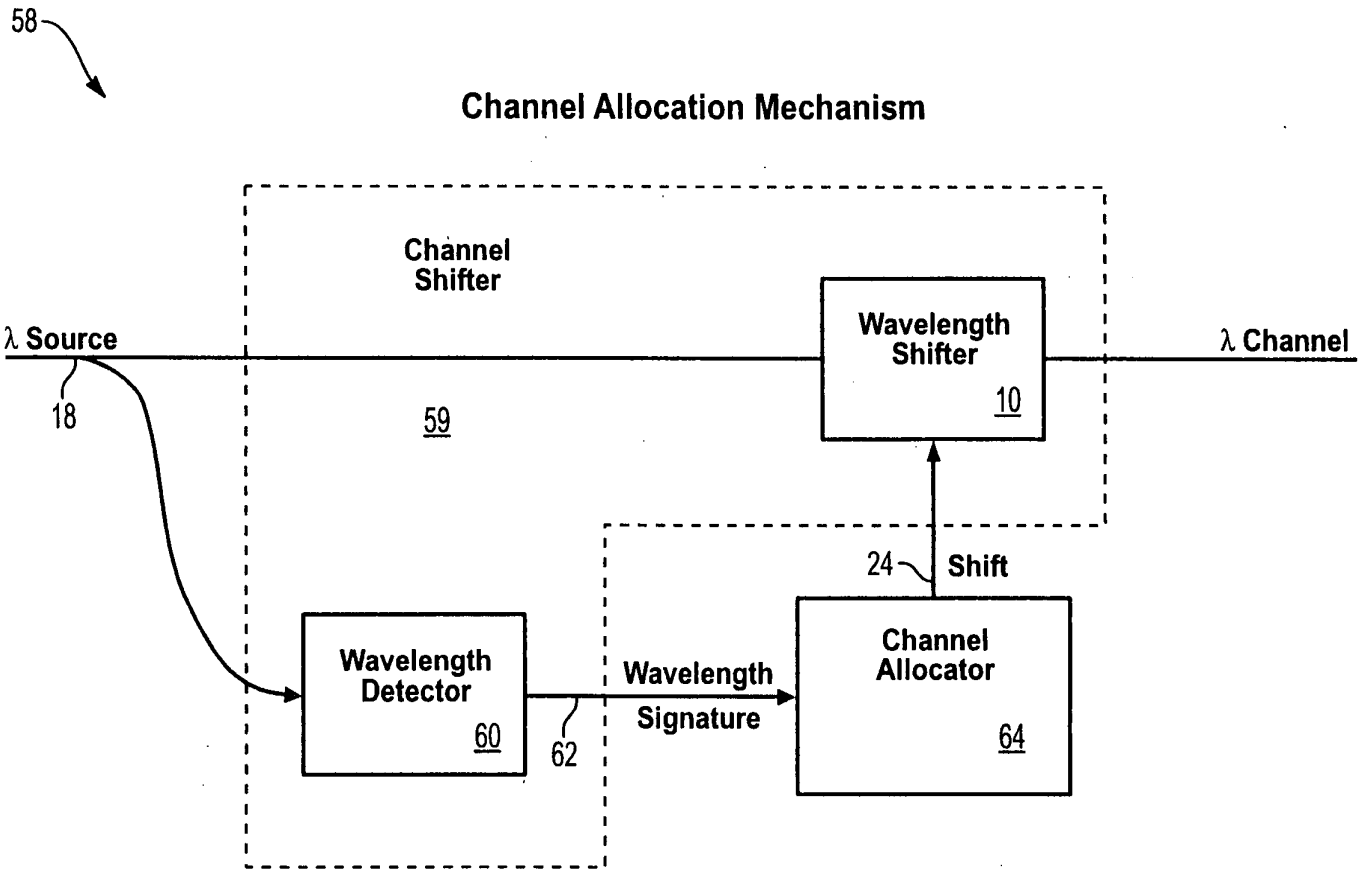
58
Channel Allocation Mechanism
Channel Shifter
λ Source
18
59
Wavelength Shifter
10
λ Channel
24
Shift
Wavelength Detector
60
62
Wavelength Signature
Channel Allocator
64

FIG. 11

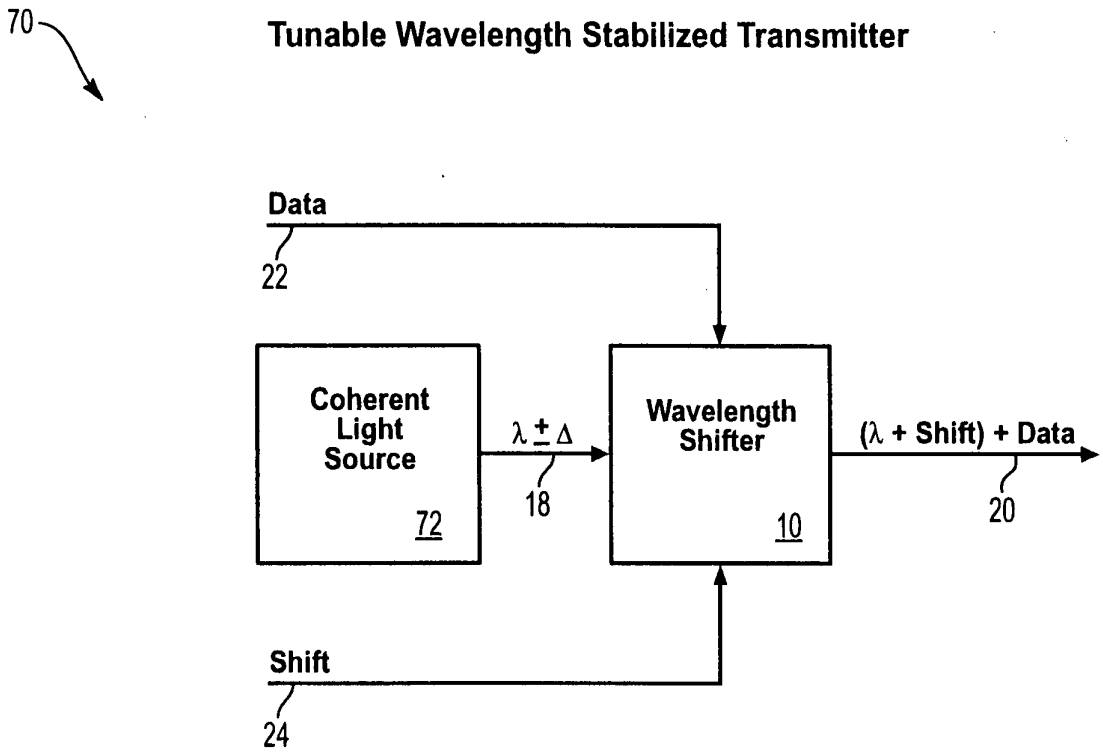
70
Tunable Wavelength Stabilized Transmitter
Data
22
Coherent Light Source
72
λ ± Δ
18
Wavelength Shifter
10
(λ + Shift) + Data
20
Shift
24

FIG. 12

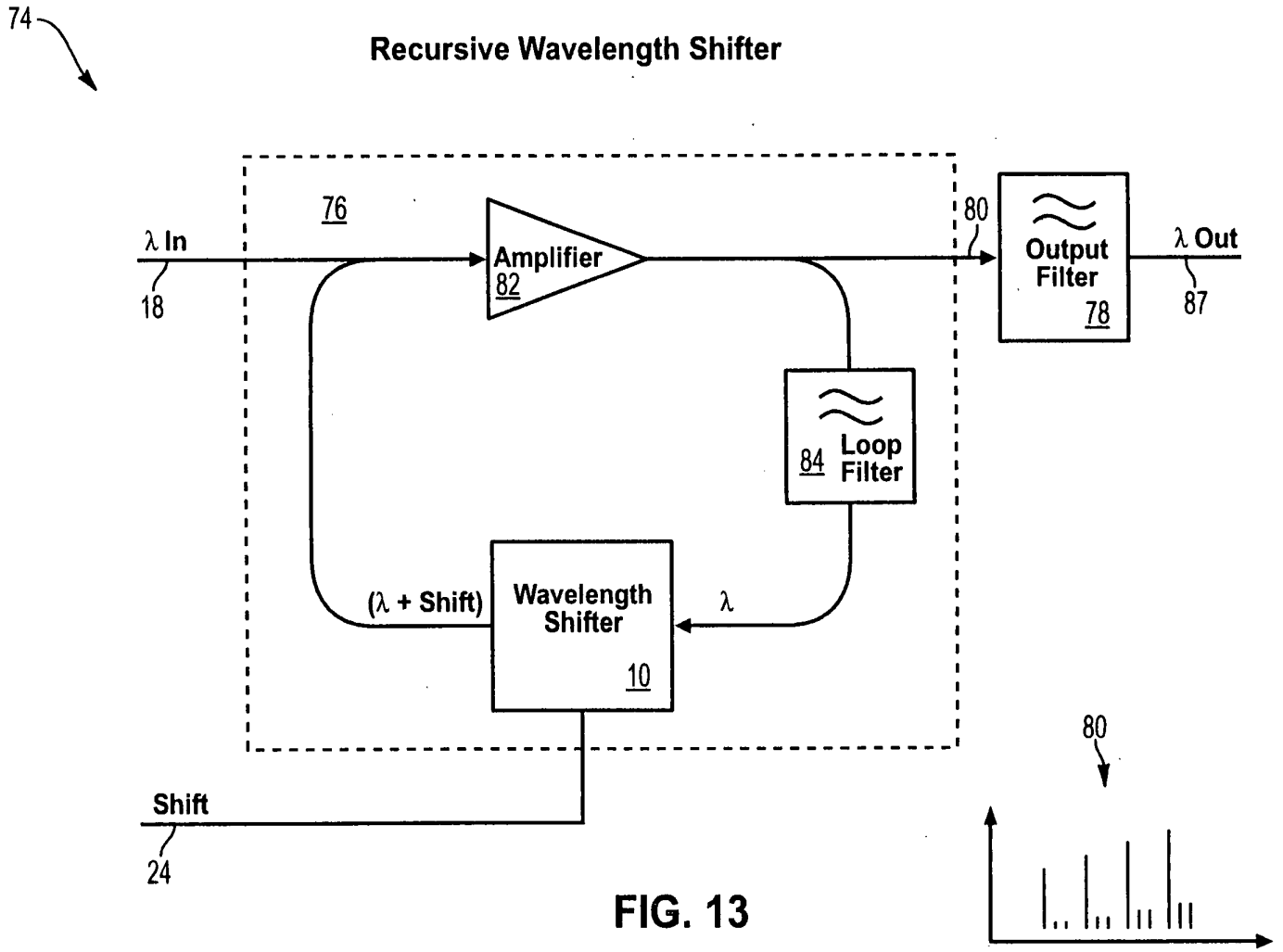

FIG. 13

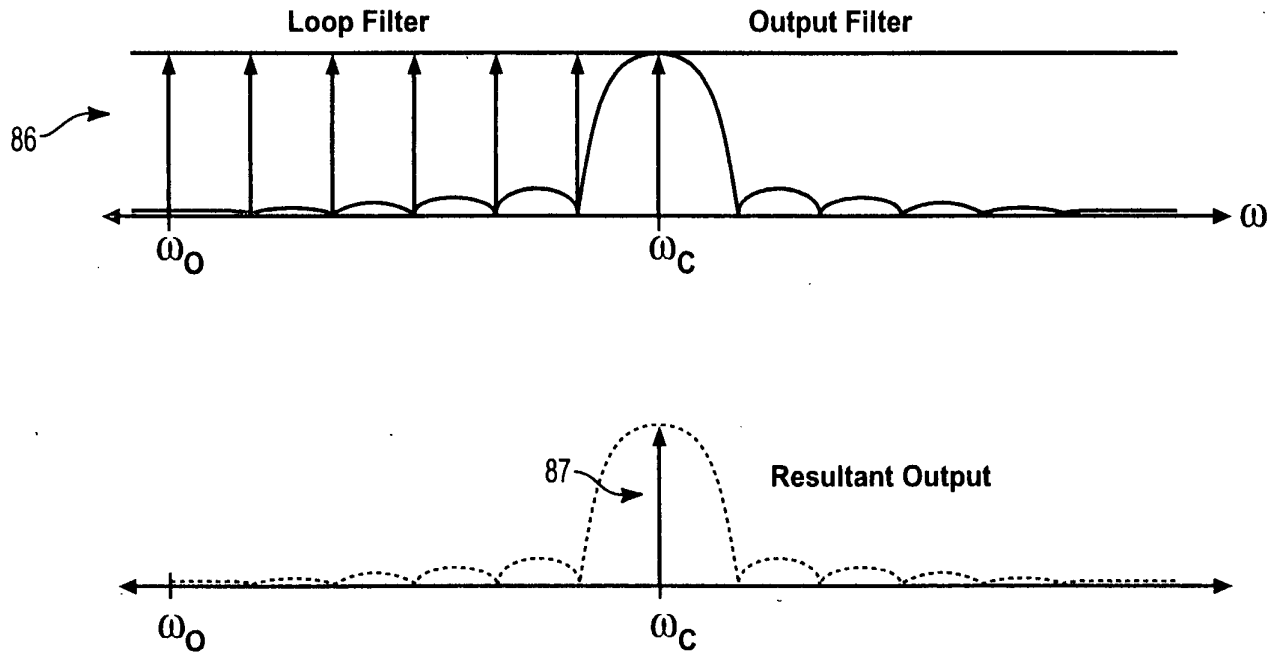

FIG. 14

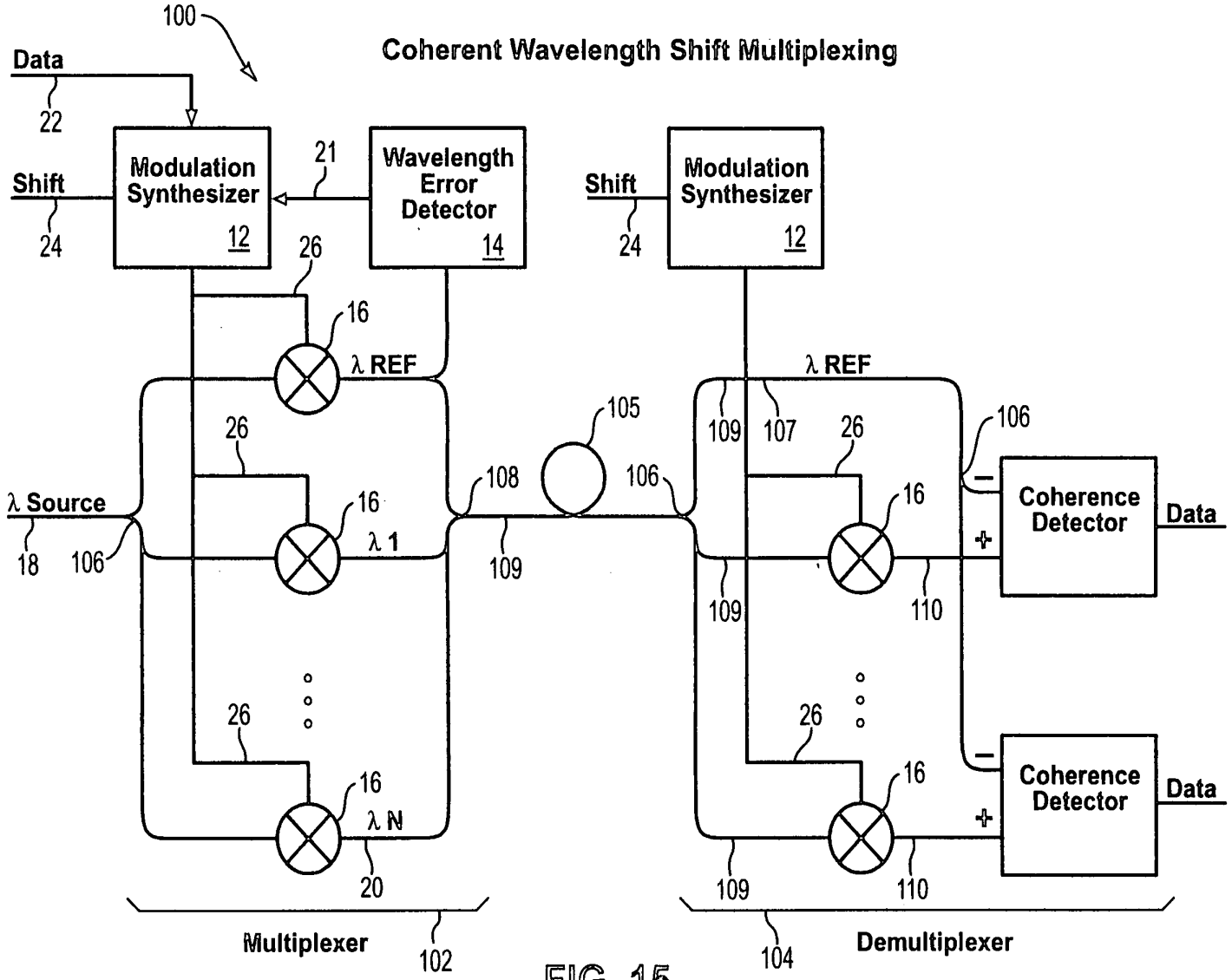
100
Coherent Wavelength Shift Multiplexing
Data
22
Shift
24
Modulation Synthesizer
12
21
Wavelength Error Detector
14
Shift
24
Modulation Synthesizer
12
26
16
λ REF
λ REF
105
109
107
26
106
λ Source
18
106
26
16
λ 1
108
109
106
16
Coherence Detector
Data
109
110
26
16
λ N
20
26
16
Coherence Detector
Data
109
110
Multiplexer
102
104
Demultiplexer

FIG. 15

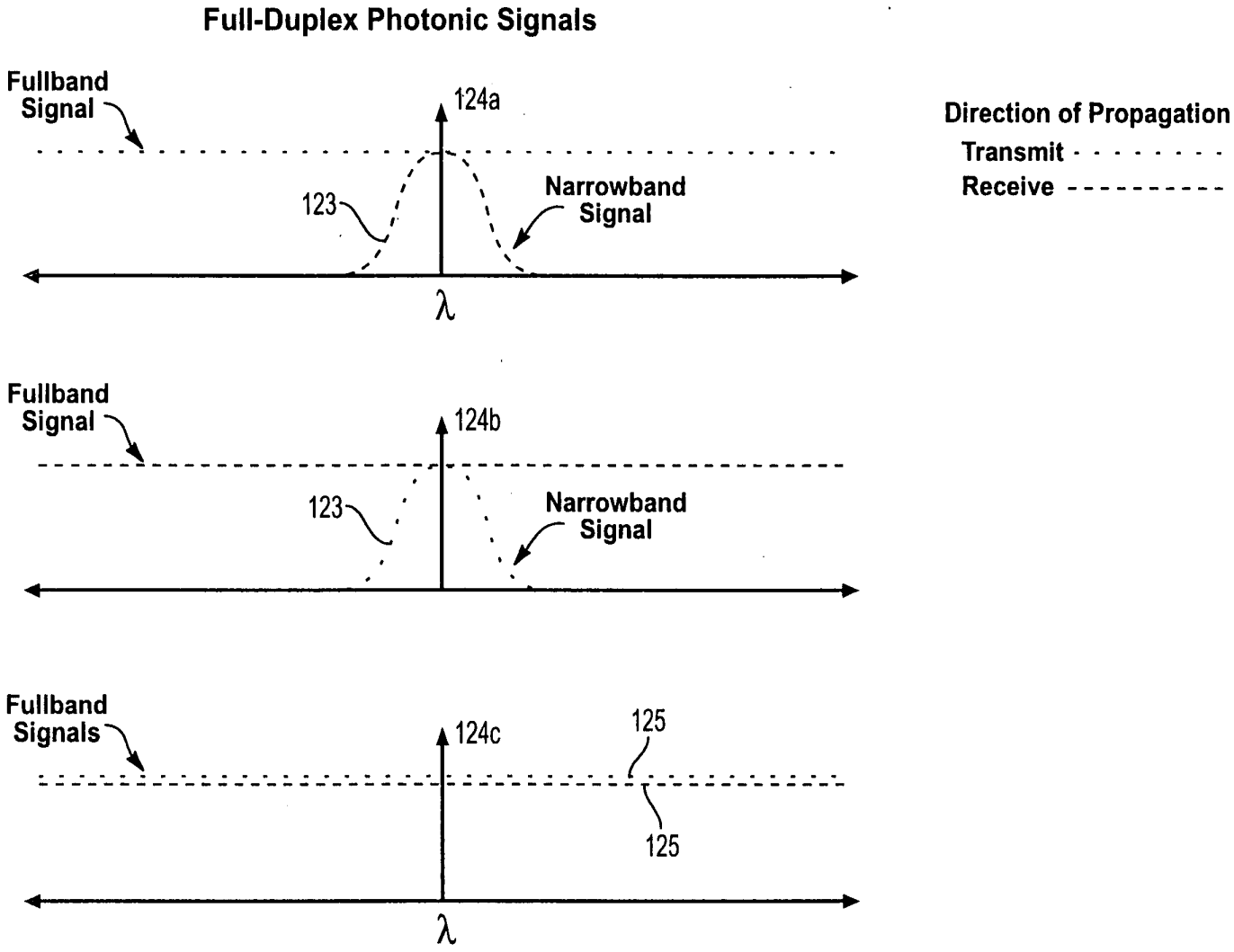
Full-Duplex Photonic Signals
Fullband Signal
124a
123
Narrowband Signal
λ
Fullband Signal
124b
123
Narrowband Signal
Fullband Signals
124c
125
125
λ
Direction of Propagation
Transmit
Receive

FIG. 16

Wavelength–Shifting Transceivers

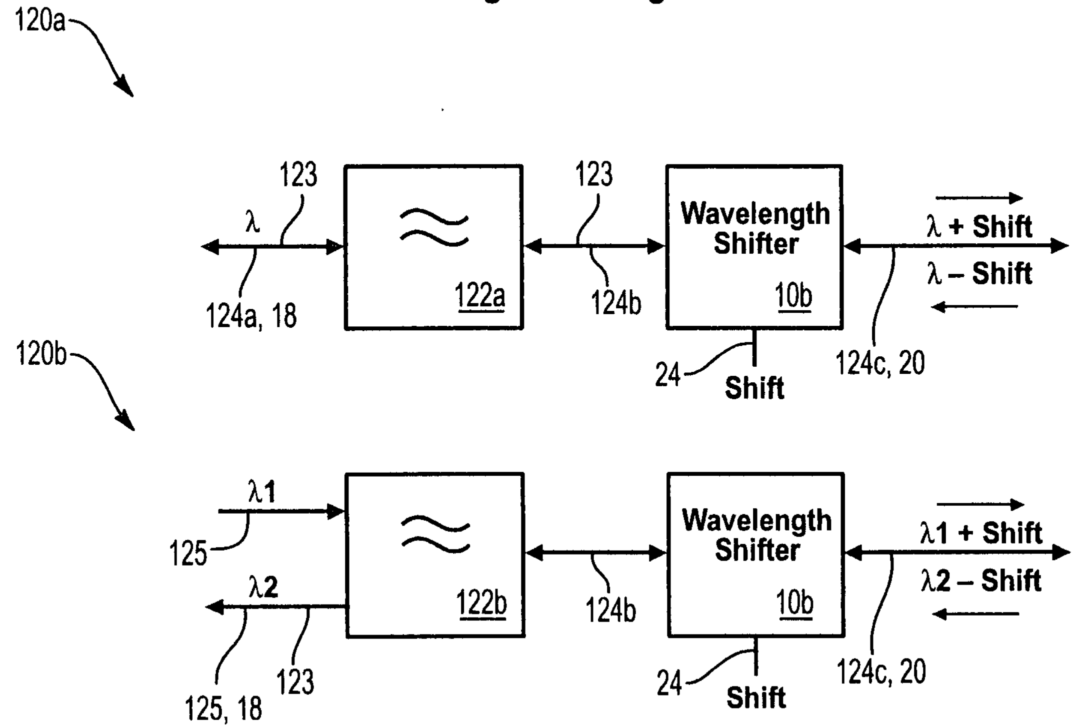

FIG. 17

Full-Duplex Narrowband Filters

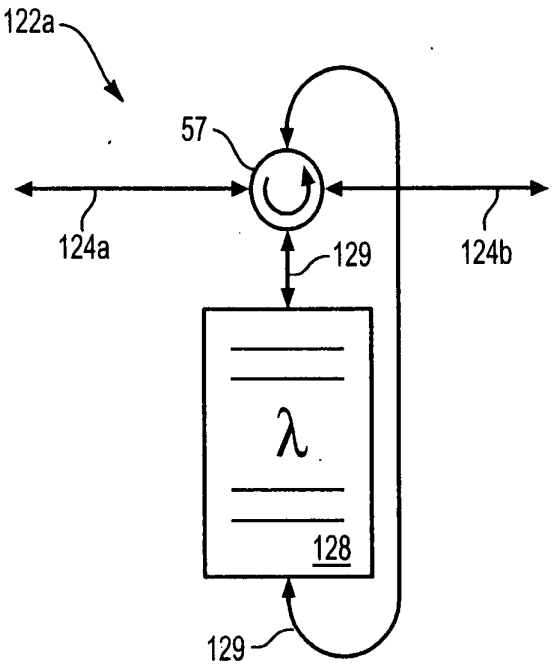

FIG. 18a

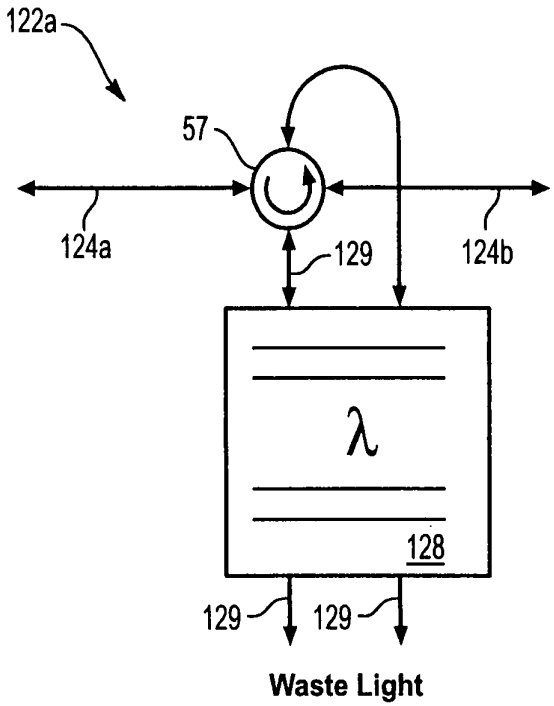

FIG. 18b

Pseudo Full–Duplex Narrowband Filter

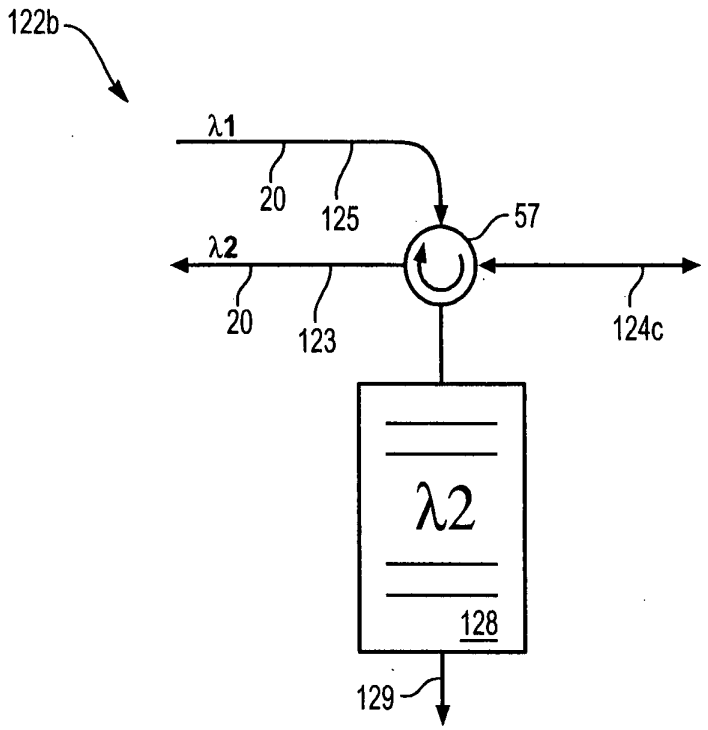

FIG. 19

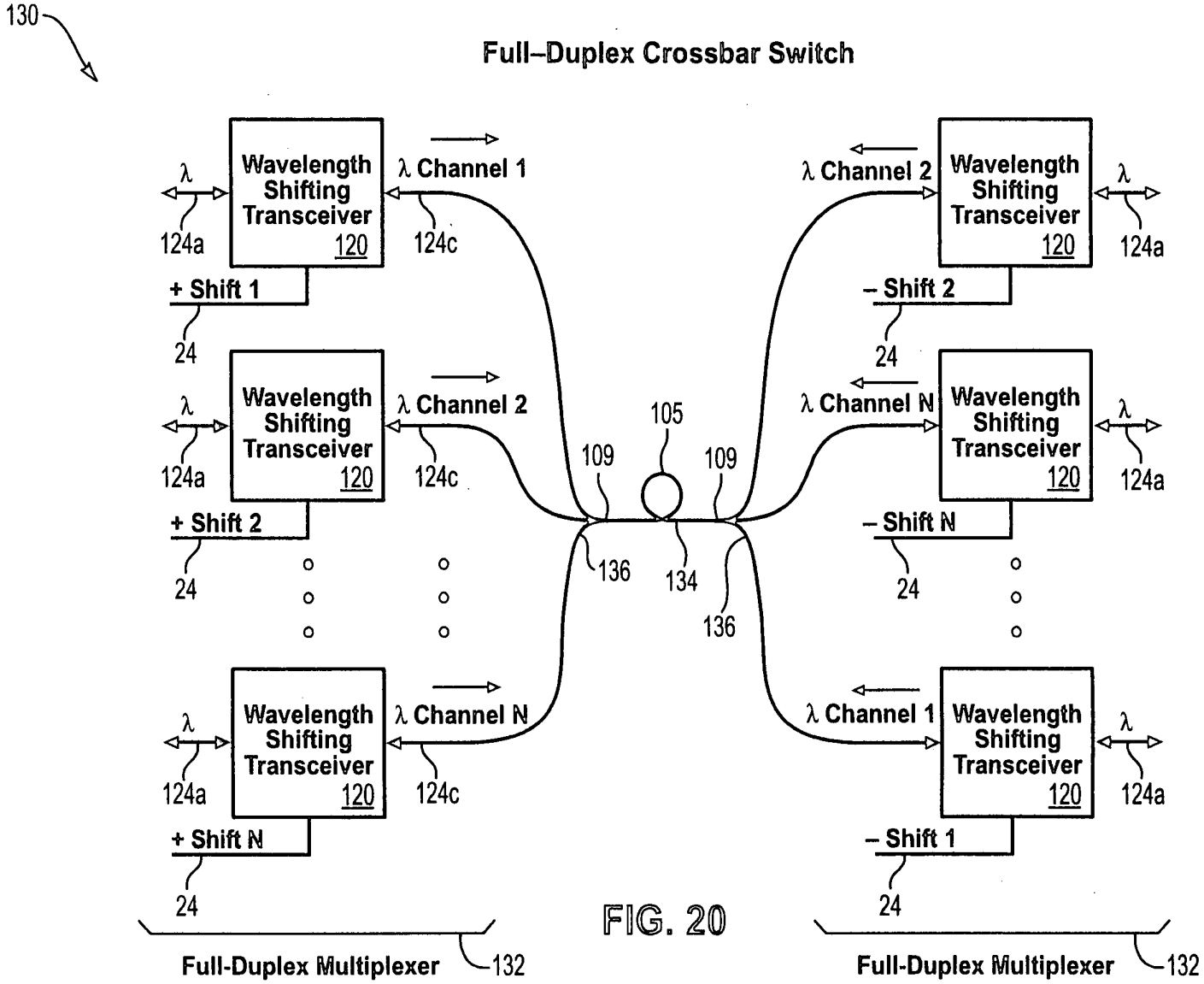

FIG. 20

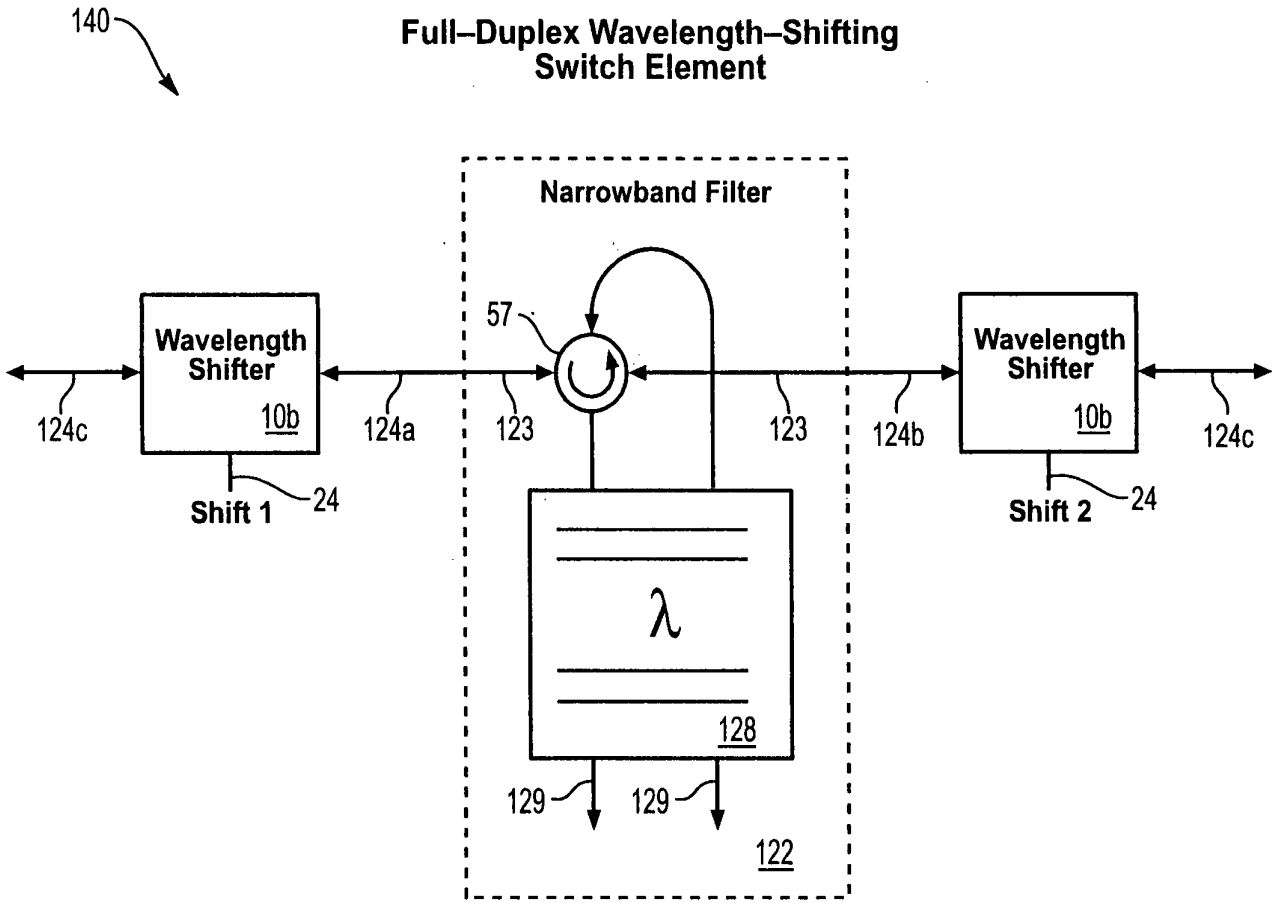
140
Full–Duplex Wavelength–Shifting Switch Element
Narrowband Filter
Wavelength Shifter
10b
57
124c
124a
123
123
124b
Wavelength Shifter
10b
124c
Shift 1
24
Shift 2
24
λ
128
129
129
122

FIG. 21

Full–Duplex Wavelength–Shifting Switch

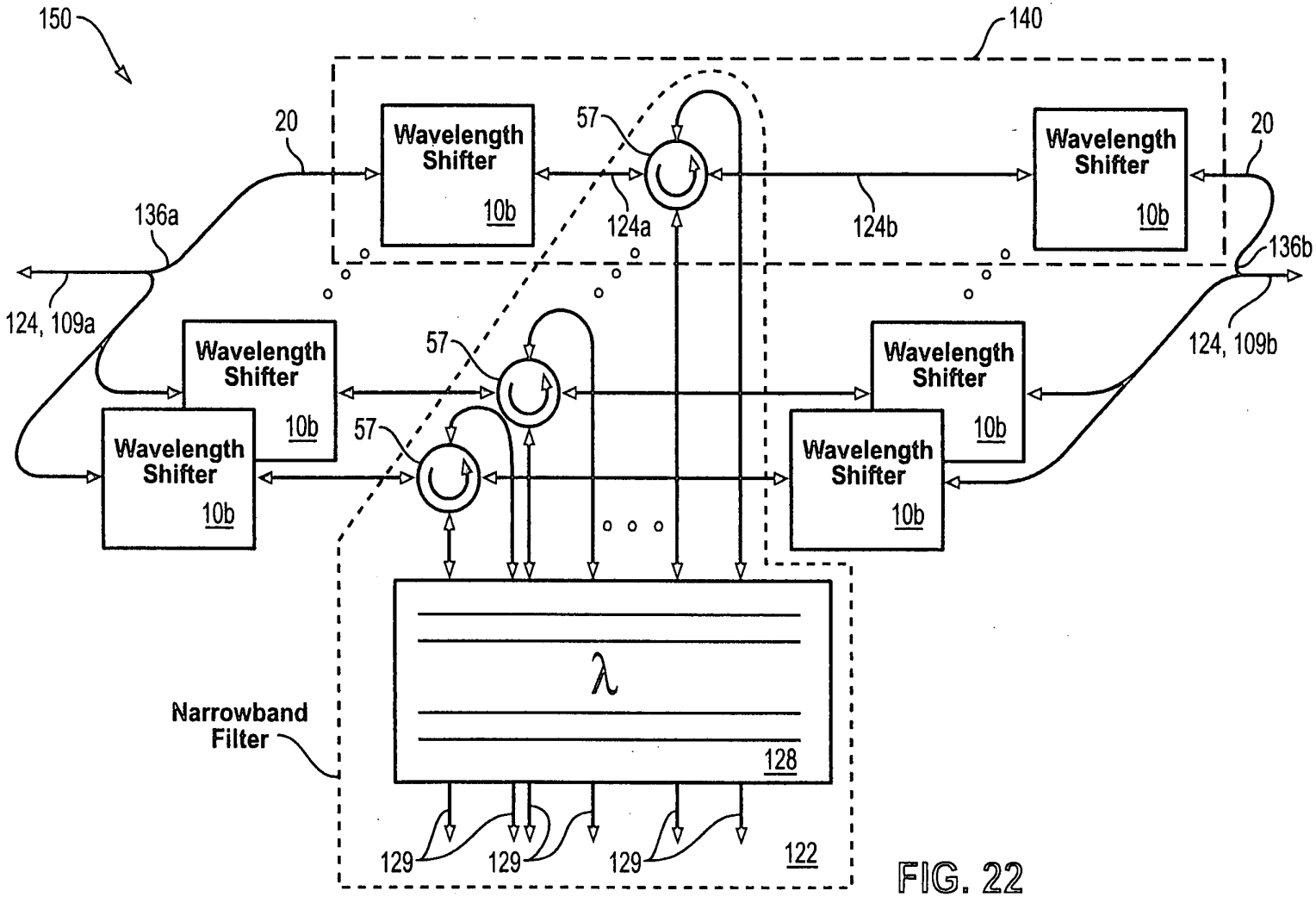

FIG. 22

160

Replicated–Spectrum Transceiver

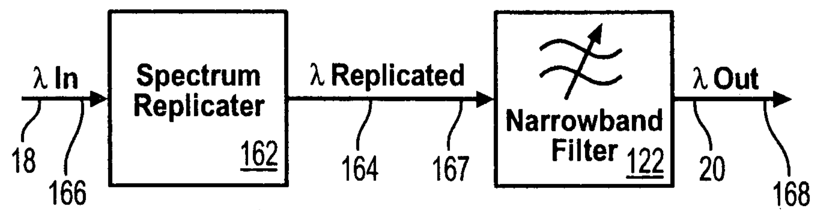

FIG. 23

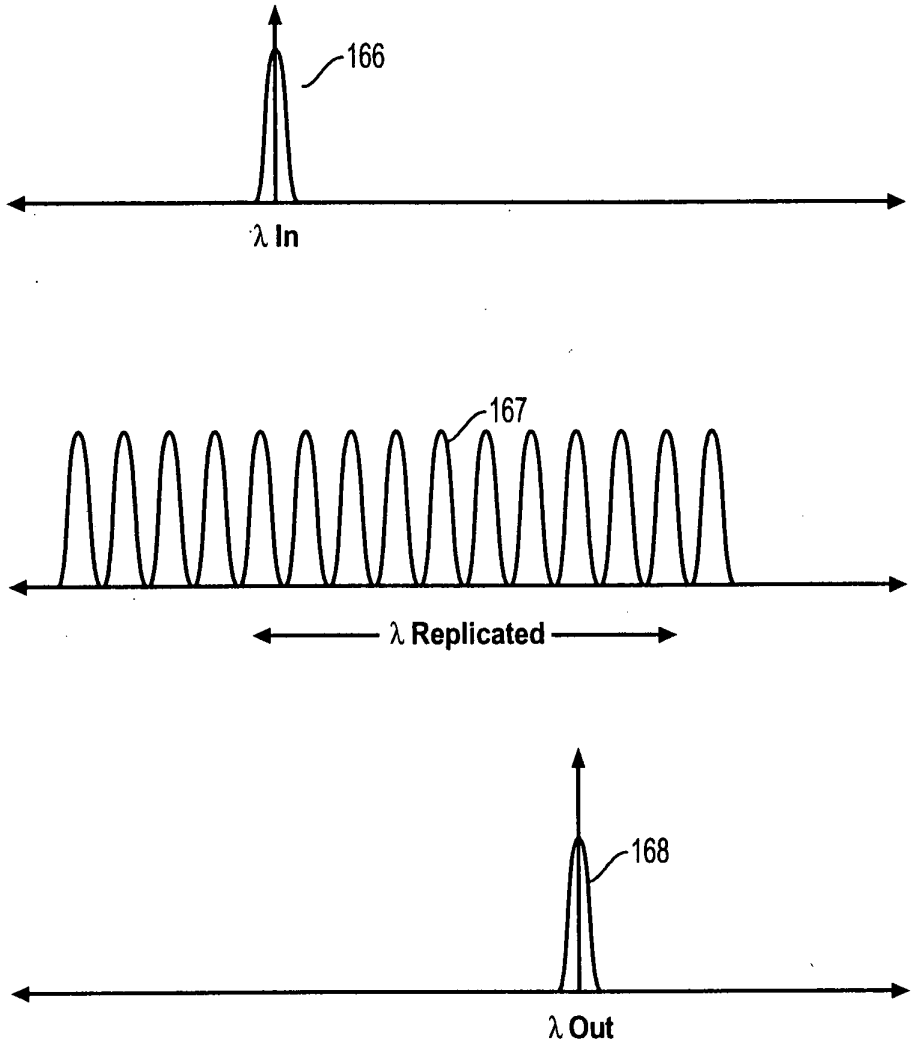

FIG. 24

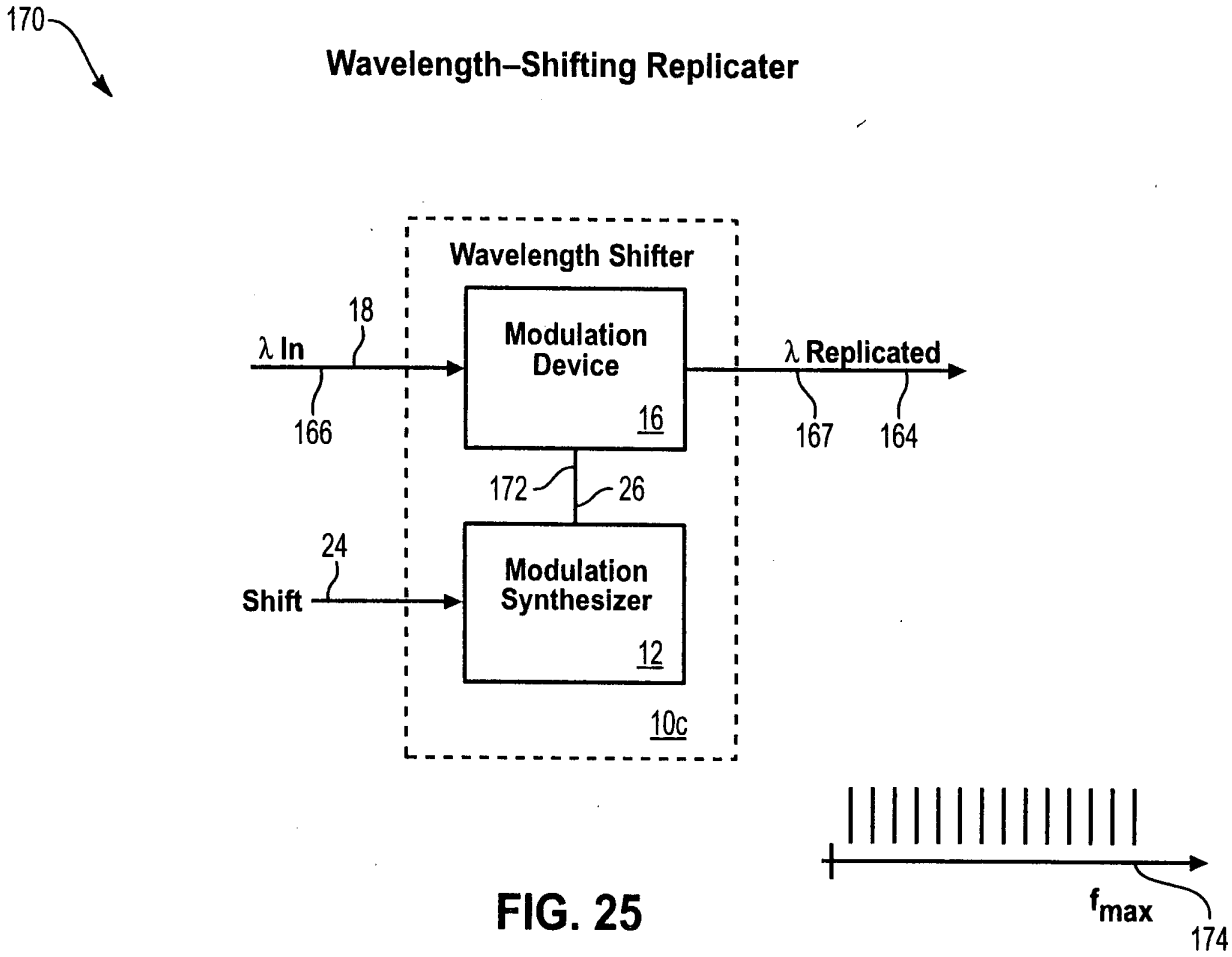
170
Wavelength–Shifting Replicater
Wavelength Shifter
18
λ In
166
Modulation Device
16
λ Replicated
167
164
172
26
24
Shift
Modulation Synthesizer
12
10c
fmax
174

FIG. 25

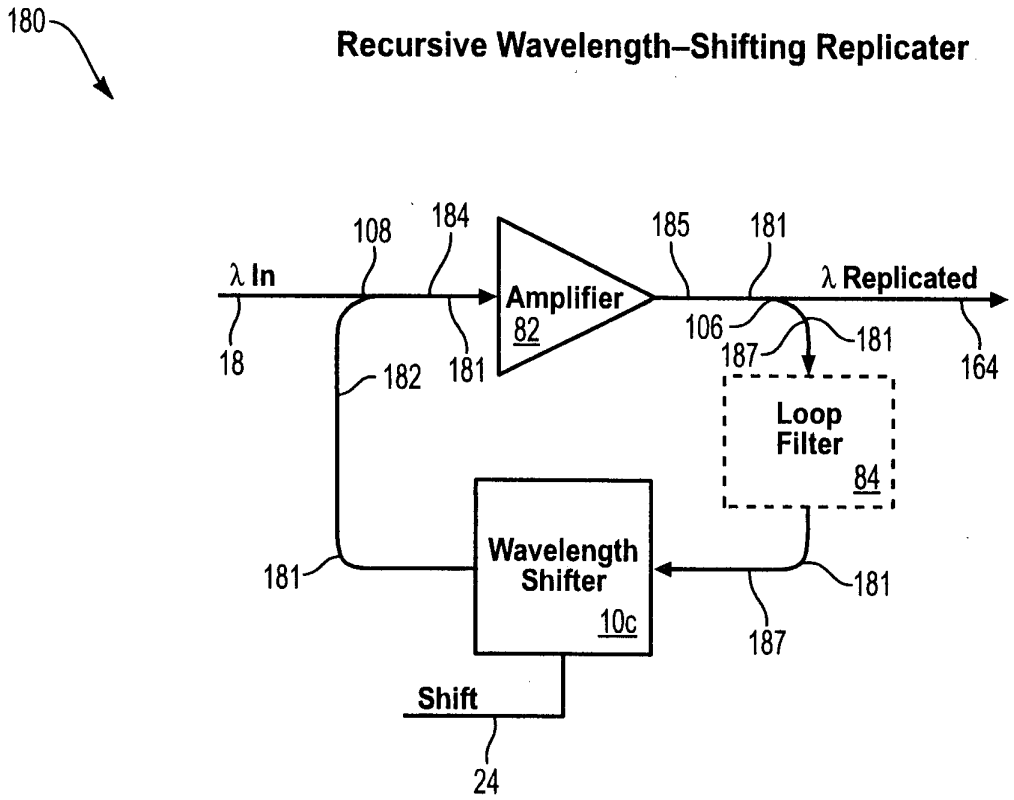

FIG. 26

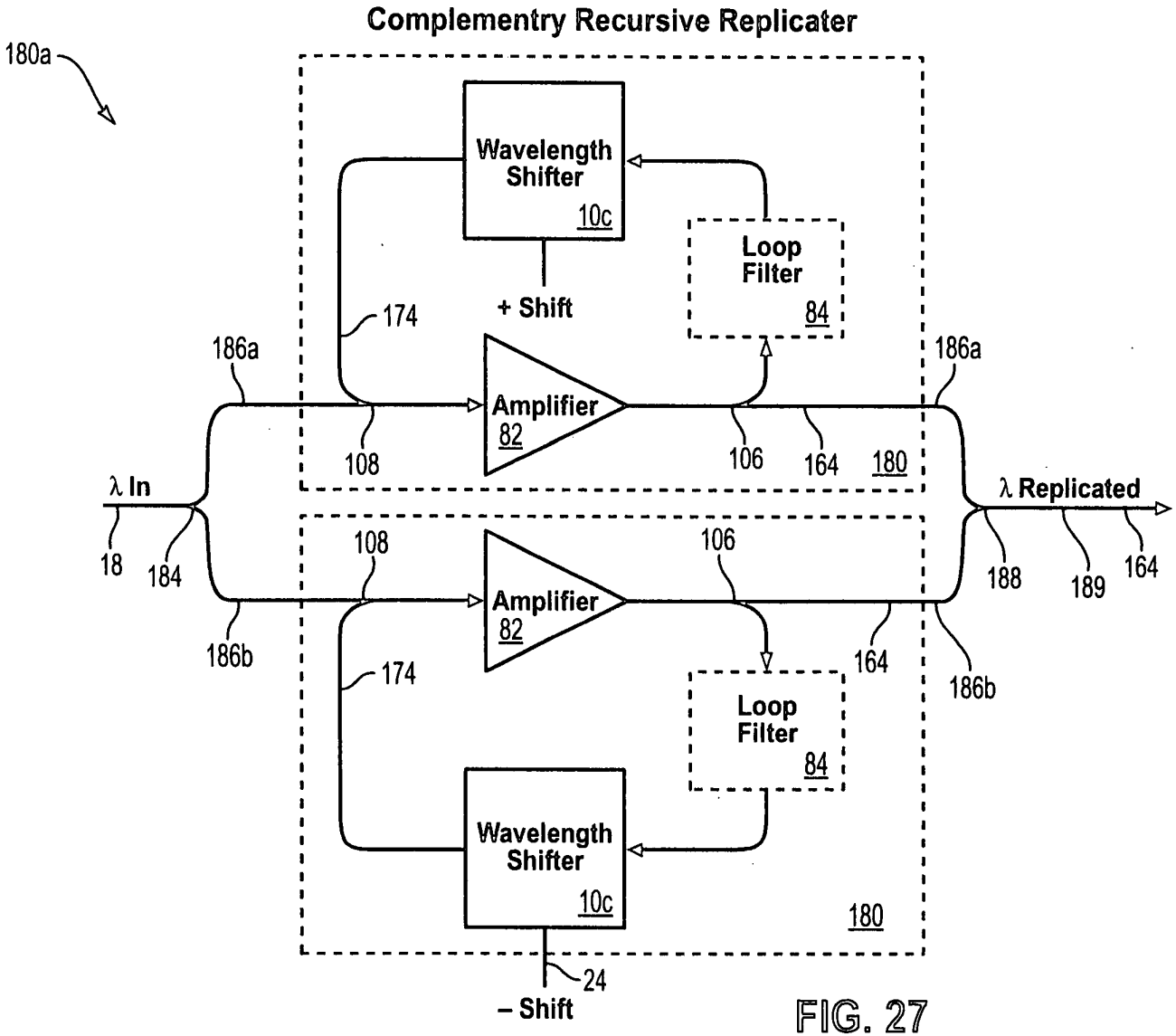
Complementry Recursive Replicater
180a
Wavelength Shifter
10c
Loop Filter
84
+ Shift
174
186a
Amplifier
82
108
106
164
180
λ In
18
184
λ Replicated
188
189
164
186b
Amplifier
82
174
Loop Filter
84
Wavelength Shifter
10c
180
24
– Shift

FIG. 27

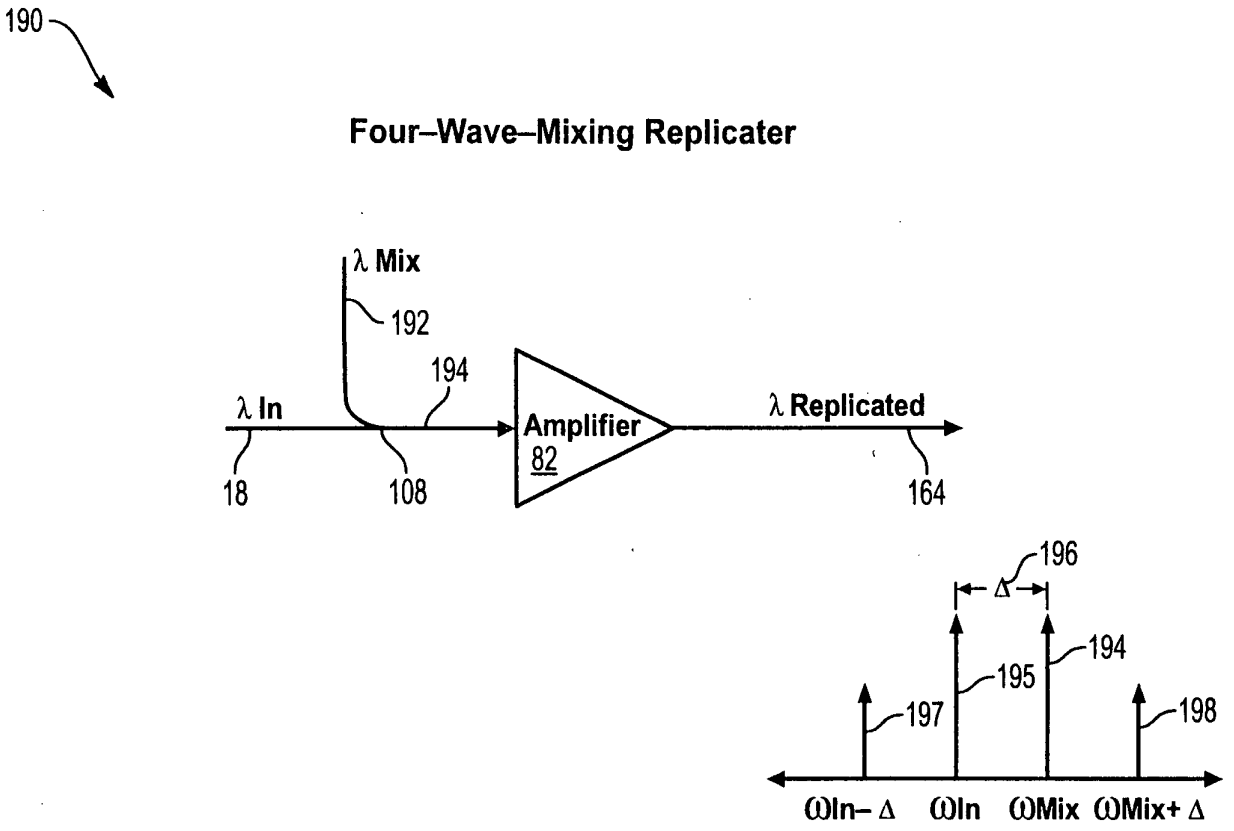
190
Four–Wave–Mixing Replicater
λ Mix
192
194
λ In
Amplifier
82
λ Replicated
18
108
164
196
Δ
194
195
197
198
ωIn– Δ
ωIn
ωMix
ωMix+ Δ

FIG. 28

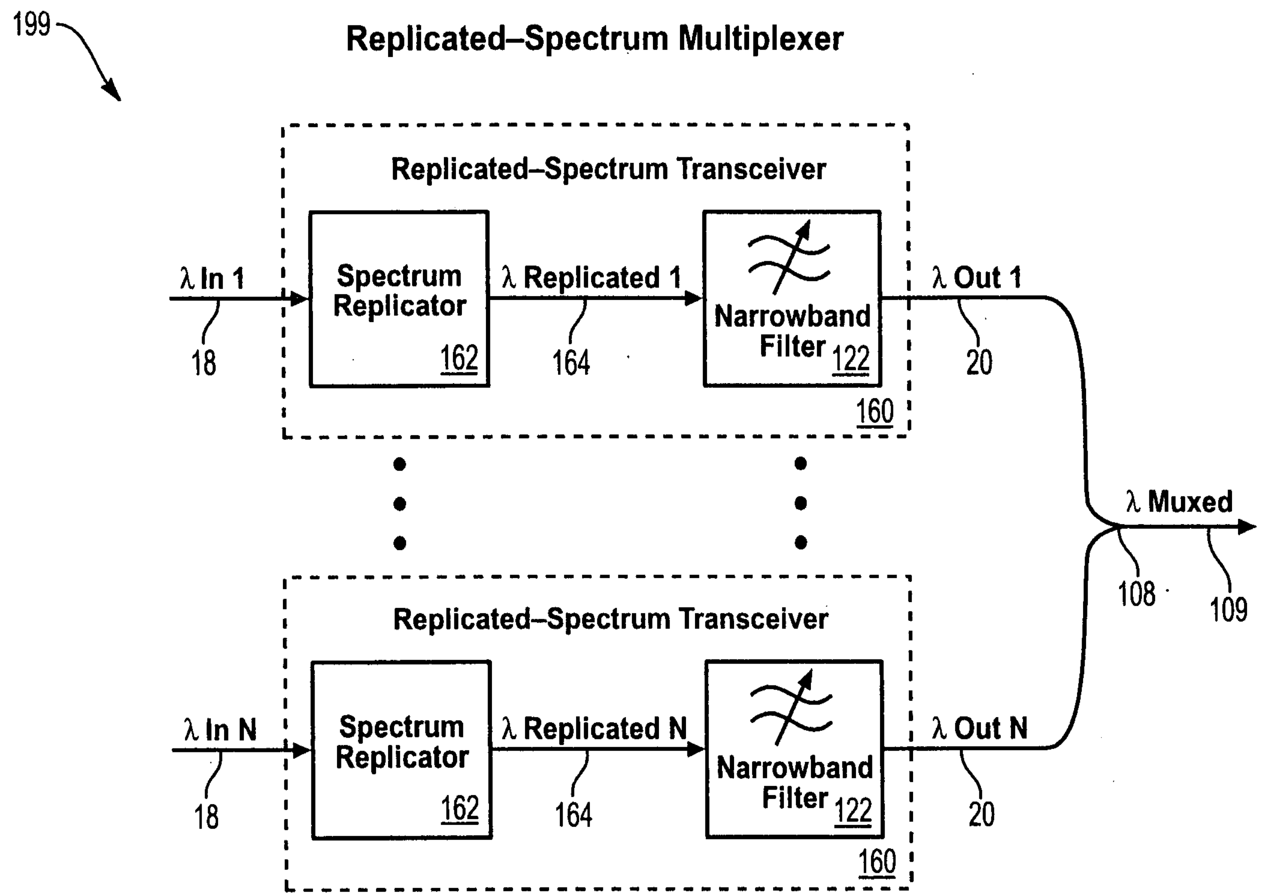
199
Replicated–Spectrum Multiplexer
Replicated–Spectrum Transceiver
λ In 1
18
Spectrum
Replicator
162
λ Replicated 1
164
Narrowband
Filter
122
160
λ Out 1
20
Replicated–Spectrum Transceiver
λ In N
18
Spectrum
Replicator
162
λ Replicated N
164
Narrowband
Filter
122
160
λ Out N
20
λ Muxed
108
109

FIG. 29

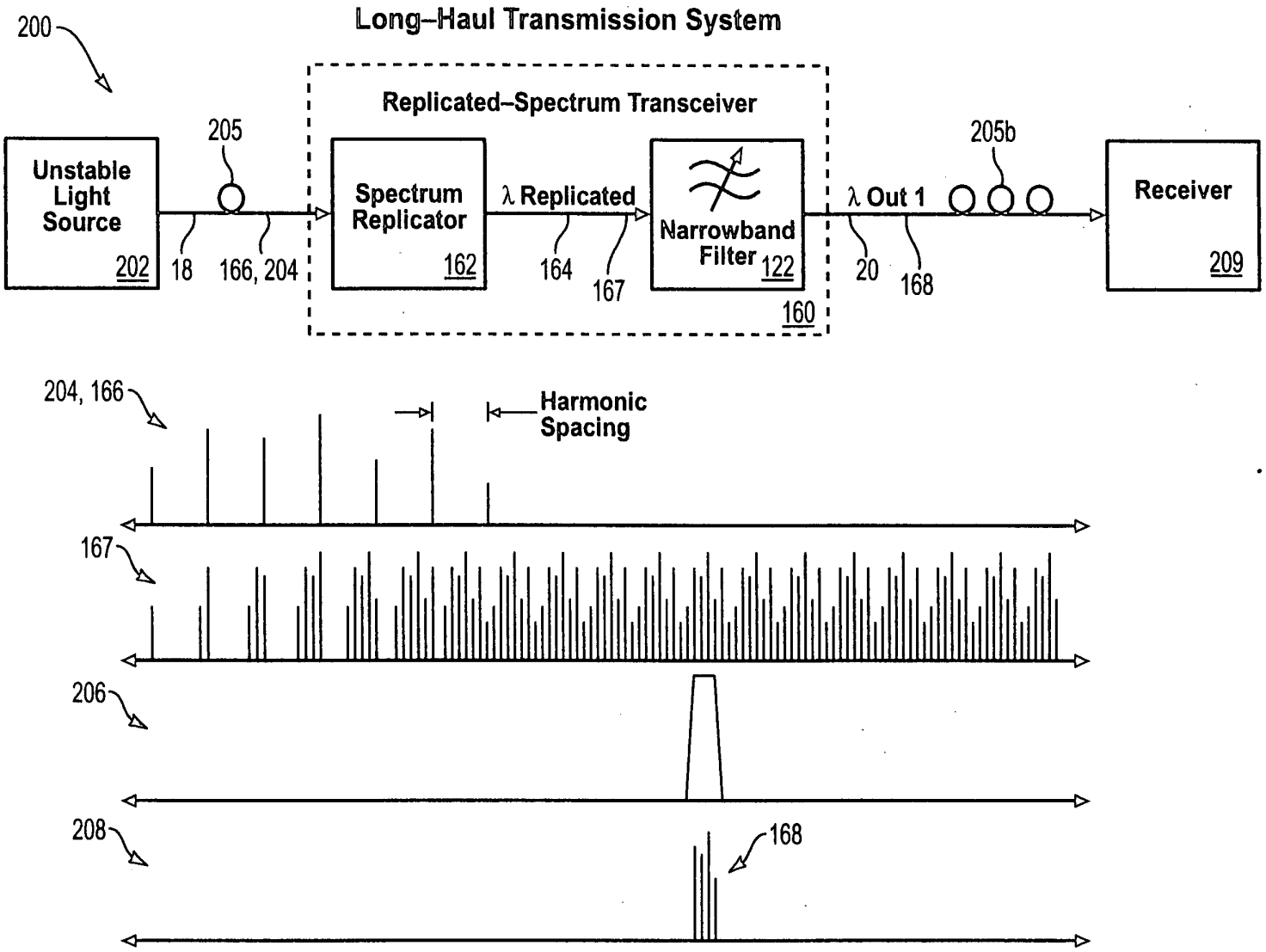
Long–Haul Transmission System
200
Replicated–Spectrum Transceiver
Unstable Light Source
202
205
18
166, 204
Spectrum Replicator
162
λ Replicated
164
167
Narrowband Filter
122
160
λ Out 1
20
168
205b
Receiver
209
204, 166
Harmonic Spacing
167
206
208
168

FIG. 30

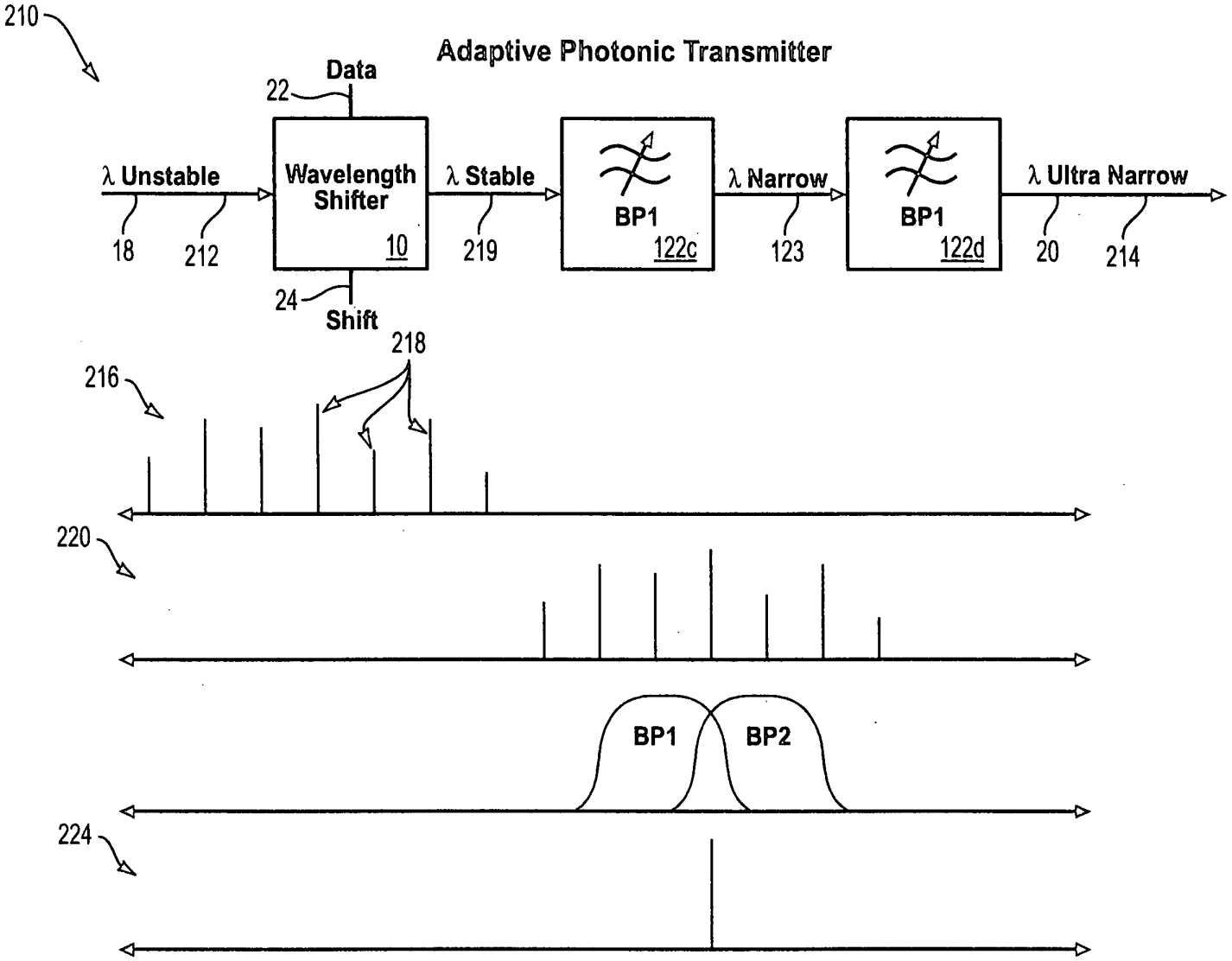

FIG. 31

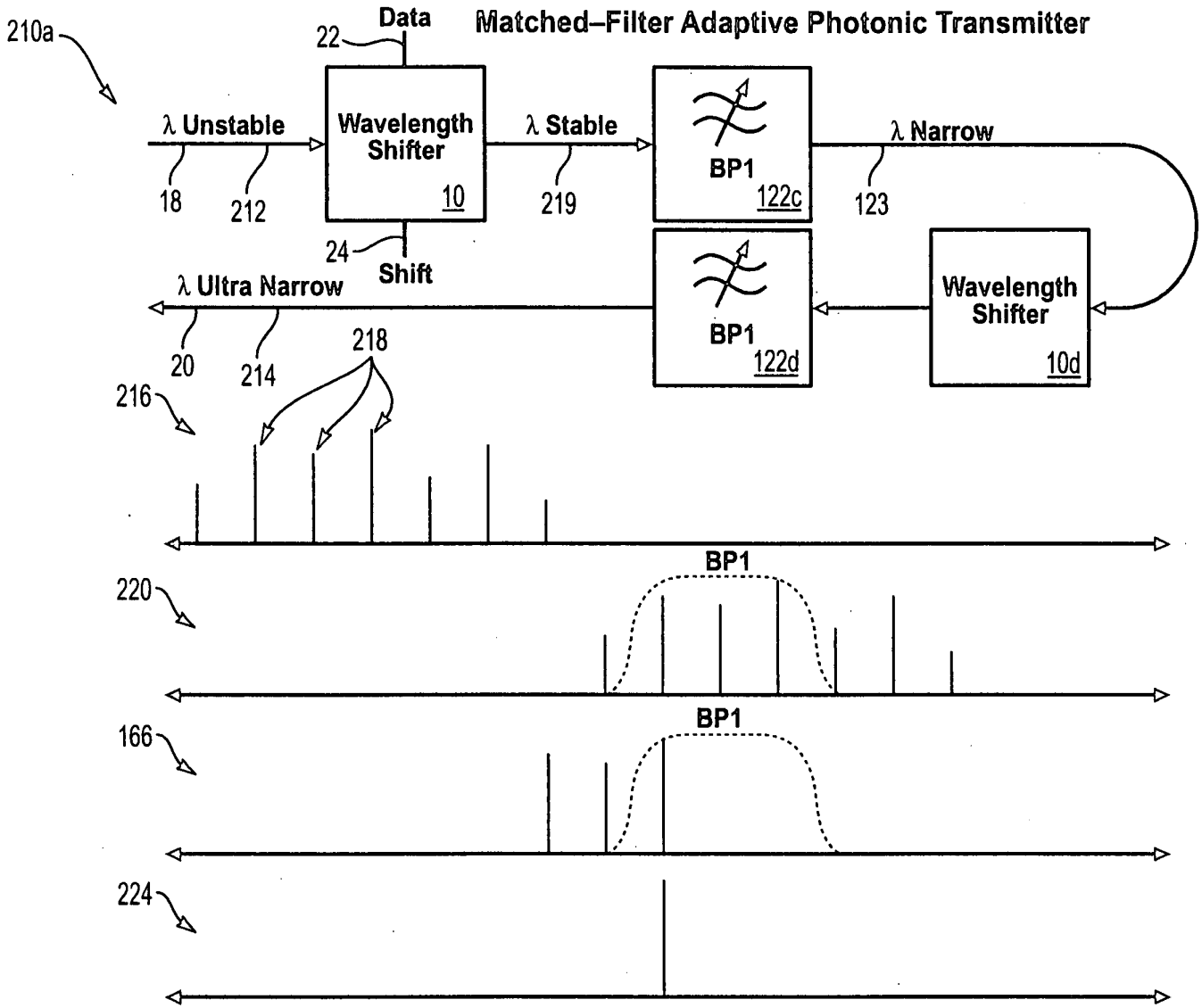
210a
Data
22
Matched–Filter Adaptive Photonic Transmitter
λ Unstable
Wavelength Shifter
10
λ Stable
BP1
122c
λ Narrow
18
212
219
123
24
Shift
λ Ultra Narrow
BP1
122d
Wavelength Shifter
10d
20
214
218
216
BP1
220
BP1
166
224

FIG. 32